

1,3-D EMISSION REDUCTION WITH DRIP IRRIGATION

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Methyl Bromide (MeBr) has recently been put under scrutiny for its stratospheric ozone depletion Potential. To meet the urgent demand of reducing MeBr inputs into the atmosphere but maintaining pest control, there is a need for alternatives to MeBr while maintaining effective pest control without environmental adverse effects. 1,3-dichloropropene (1,3-D) is a soil fumigant which may be used as an alternative to MeBr, since it does not destroy stratospheric ozone. However, 1,3-D use in California is currently restricted to low rates and specified application conditions because of its air-emission losses. To reduce its emission, alternative management methods may be needed to retard its transport to the soil surface where the emission occurs. Alternatively, a containment with low permeability barriers such as a layer of polyethylene (PE) film cover at the surface may be used to reduce its emission into the atmosphere. In this study, we measured 1,3-D emission from a bedded system where 1,3-D was applied by (A) surface drip irrigation and covered with PE film, (B) subsurface drip irrigation at 20 cm depth, and (C) shank injection at 30 cm. The purpose was to determine the effectiveness of reducing 1,3-D emission with drip irrigation, as compared to the conventional shank injection.

A field experiment was conducted on 101.6 cm (or 40") center-to-center beds which were constructed following procedures similar to a commercial field operation. In the two drip irrigation treatments, drip tapes with openings at 20 cm, (or 8") spacing were used to deliver 1,3-D with the irrigation water. A single tape was used for each bed and located at the center of the bed 2.5 cm from the soil surface for the surface drip and at 20 cm. depth for the subsurface or deep drip. The drip tapes were installed with a shank mounted on the tractor used for the bed construction. A layer of PE film was used to cover each bed for the surface drip. The edges of film were buried about 5 cm, in the furrow or bottom of the beds. An Inject-O-Meter system with a 65-gallon mixing tank was used to premix, dilute, and inject 1,3-D (Telone EC) into the irrigation system. at an application rate of 5.7 g m^{-2} (5 gallon acre⁻¹) Water and 1,3-D application for the two drip plots lasted for 8 hours. Water application was continued for an additional 2 hours after 1,3-D injection. This was to flush the drip system so that no residual 1,3-D was left in the system. Three 36.6 in (or 120') long beds were used for each of the two drip treatments. A buffer bed (i.e., without 1,3-D) was used between the two drip treatments. For the shank injection treatment, 1,3-D (Telone II) was injected to the center of the beds approximately 30 cm. below the surface using slanted shanks mounted behind a tractor. Because of the equipment configuration, four beds were injected with the chemical (in one pass) and the injection shanks left fractured traces in the furrows of the beds where the slanted shanks were placed in the soil. The application rate was 13.7 g m^{-2} (12 gallon acre⁻¹). To reduce interference, a buffer bed was used between the drip and the shank injection treatments. To measure 1,3-D emission, replicated flux chambers were placed over the top, sides, and bottom of the beds to capture 1,3-D emission from the three possible locations of a bedded system. The measurements were made in the center bed for each treatment to minimize boundary effect. Fresh, uncontaminated air was drawn from outside the field with 5-cm diameter pipes through each chamber with a vacuum system. The air passing the chamber was subsampled for analysis of 1,3-D concentrations and determination of its emission flux density. The emission was monitored continuously from the time of application till the emission was below detection limit

Preliminary results indicate that overall 1,3-D emission loss was highest for *the* shank_injection treatment followed by the surface drip with PE film cover. The deep drip treatment had the least emission loss. The emission flux density showed a similar trend (Fig. 1), i.e., the maximum flux reached about $1200 \mu\text{g m}^{-2} \text{s}^{-1}$ for the shank injection treatment, while the surface and deep drip reached only about 95 and $65 \mu\text{g m}^{-2} \text{s}^{-1}$ respectively. Close examination shows that the extremely high emission. flux or most of the losses in the shank injection treatment was from the furrow or bottom of the beds. It is possible that the less compacted traces in the furrows created by the -slanted shanks functioned as preferential paths for 1,3-D loss. For the, two drip treatments, the maximum emission fluxes occurred at the end of 1,3-D application and a second peak was reached about 10-20 hours after the first peak. The exact timing of the second peak depends on the treatment and location of the beds. For the surface drip, more 1,3-D was lost to emission from the top of the beds, followed by the sides and the furrows, This is reasonable because the drip tapes were located in the center of the bed near the surface. The PE film did not seem to be very effective in containing 1,3-D. For the deep drip, a similar amount of 1,3-D was lost from the top, sides, and furrows of the beds. This is probably caused by the similar distance from the 1,3-D source or the drip tapes to the three locations of the beds. The drip tapes were 20 an below the top about the same level as the bottom of the furrow. The horizontal distance between the tape and the furrow was about 44 cm. For the two drip treatments, most emission losses occurred in the first 4 days after 1,3-D application. For the shank injection, significant emission persisted for more than 8 days, due probably to the deeper injection depth (30 cm). In summary, it appears that applying 1,3-D with drip irrigation can significantly reduce emission, as compared to shank injection.

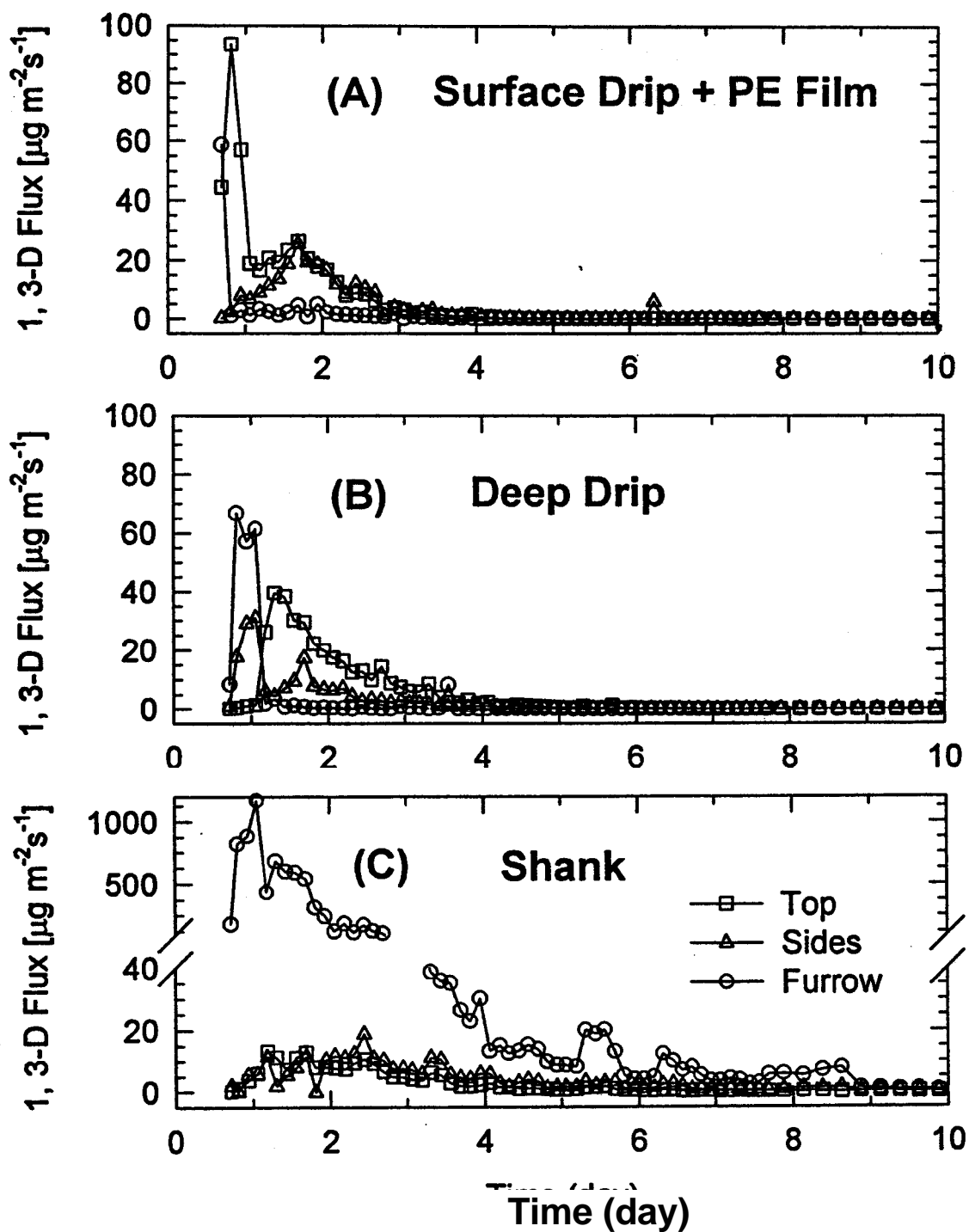


Figure 1. Volatilization of 1, 3-dichloropropene under a bedded system:
 (A) applied with surface drip irrigation (2.5 cm) and covered with polyethylene (PE) film,
 (B) applied with deep drip irrigation (20 cm),
 (C) shank injection at 30 cm depth.